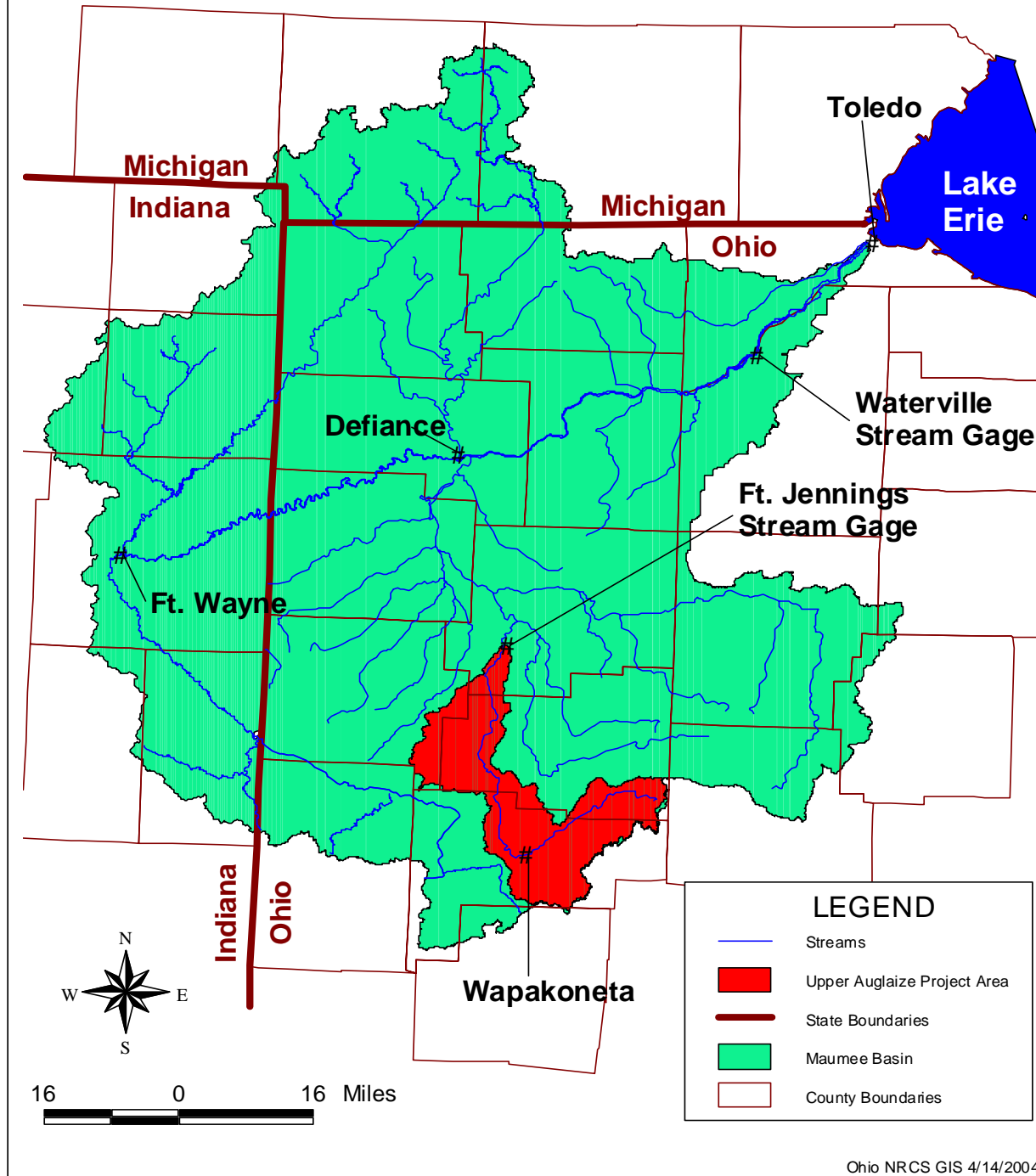


THE UPPER AUGLAIZE RIVER WATERSHED PROJECT



AGNPS Modeling for Sediment & Nutrient Reduction

Upper Auglaize Project Area Maumee River Basin

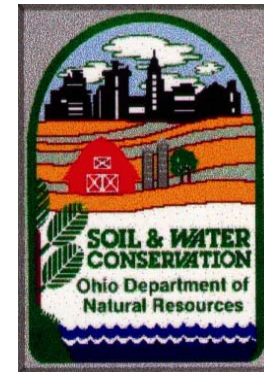
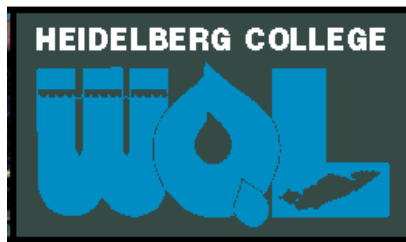


What is it? (continued)

The project applied the USDA-ARS
Agricultural Non-Point Source (AGNPS)
pollution model to:

- **Determine watershed erosion, sediment yields & loads**
- **Develop effective conservation treatment strategies**
- **In the future - Determine nutrient yields & loads**

Who is involved?



Goals of the project are

**Find sources of
sediment**



....Quantify Amounts

Goals of the project are

**Understand watershed effect
links to Lake Erie...**



**.....Develop new technology
For riparian buffers**

Ephemeral gully erosion scours soil from the edge of a soybean field before it is delivered to the Auglaize River. Storm of June 12, 2004.



Erosion delivers sediment from clean tilled field in Auglaize River Watershed. This field had been in the whole field Conservation Reserve Program (CRP), but was not selected for reenrollment and after 10 years was converted from grassland back into production this year.



Ephemeral gully erosion scours soil from the edge of a soybean field and delivers it to a tributary of the Auglaize River.



Sheet erosion scours soil from the edge of a clean till field before it is delivered to the Auglaize River.



Sheet, rill and ephemeral gully erosion scours soil from the edge of a clean tilled field. Sediment removed was delivered to a tributary stream 500' down slope and on to the Auglaize River.



What is AGNPS?

AGNPS is a joint USDA-ARS and USDA-NRCS *suite of computer models* developed to:

Predict non-point source pollutant loadings and their origin within agricultural watersheds.



AGNPS is a suite of computer models that provide:

- GIS-supported input generation & editing, and their associated databases (AGNPS/ArcView Interface);
- a continuous-simulation pollutant loading model for agricultural-related watersheds (AnnAGNPS);
- various routines to analyze and reformat output
- integration of more comprehensive routines (CCHE1D) for the stream network processes.

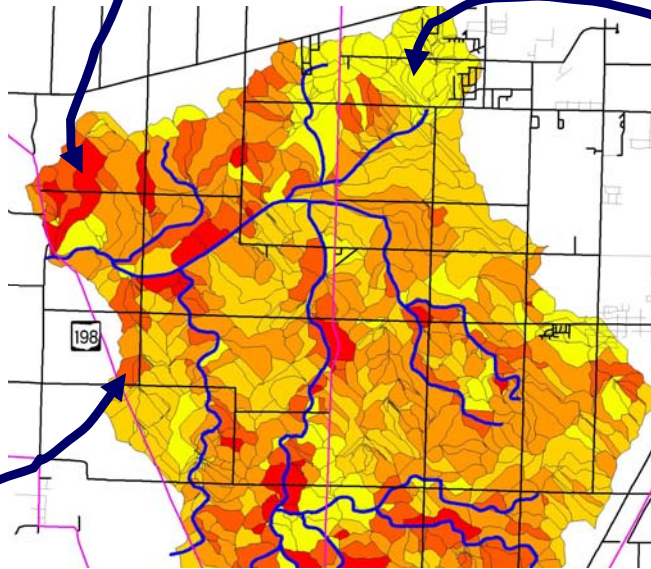
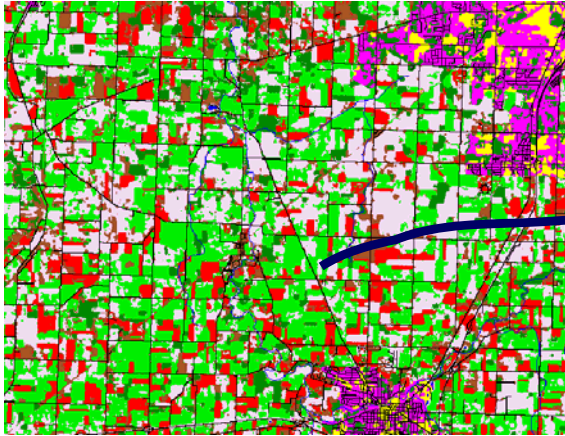
What was done?

The project partners collected and assimilated in GIS format the following data necessary to run the model:

- Weather
- Topographic Information(DEMs)
- Soils
- Landuse
- Crop Management Systems & Conservation Practices

The model was utilized by NRCS for various combinations of existing conditions and future potential management scenarios

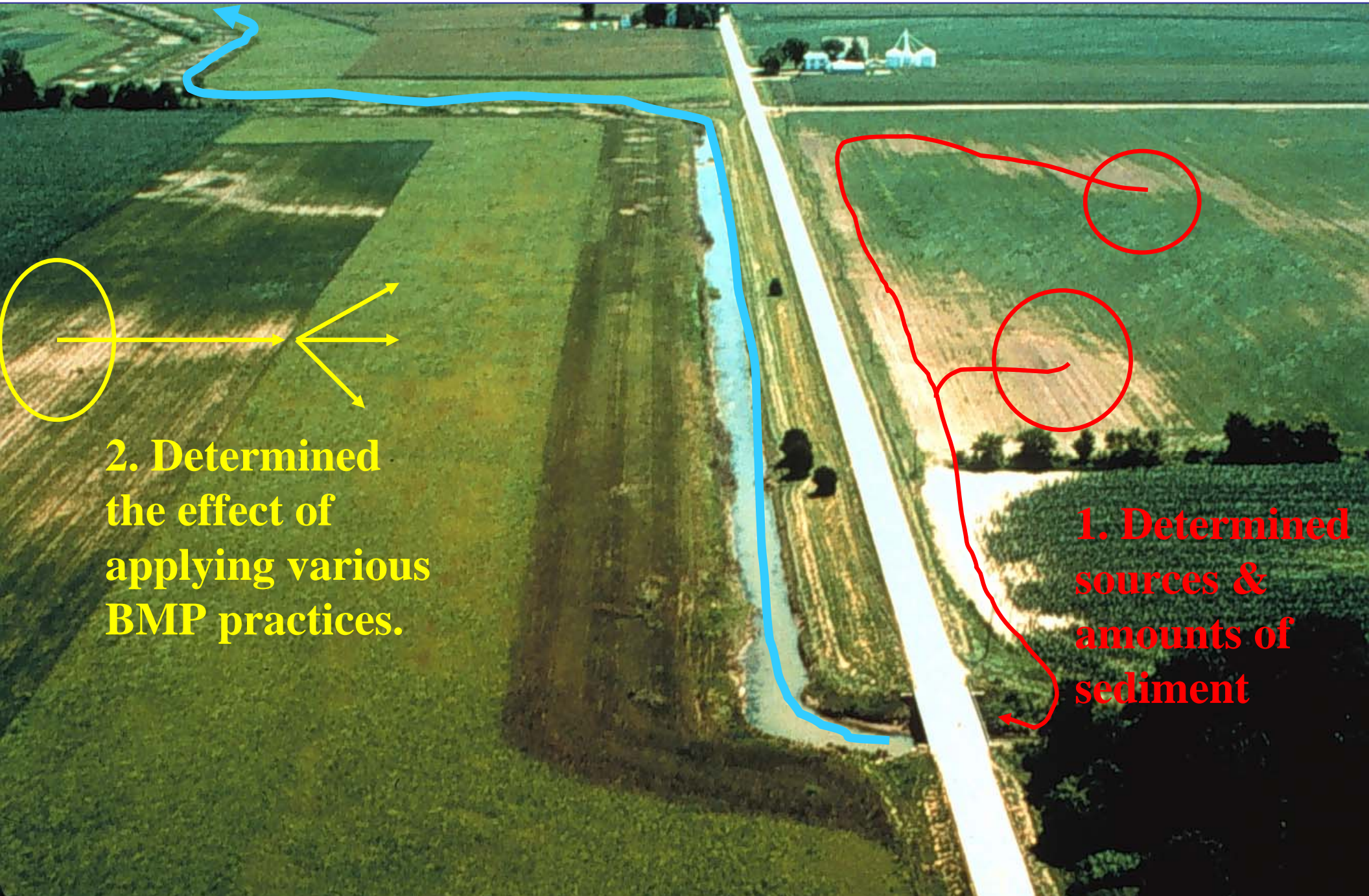
How did it work?



Existing or proposed crops, tillage, soils, slopes,
etc. are linked to cells for conditional runs.

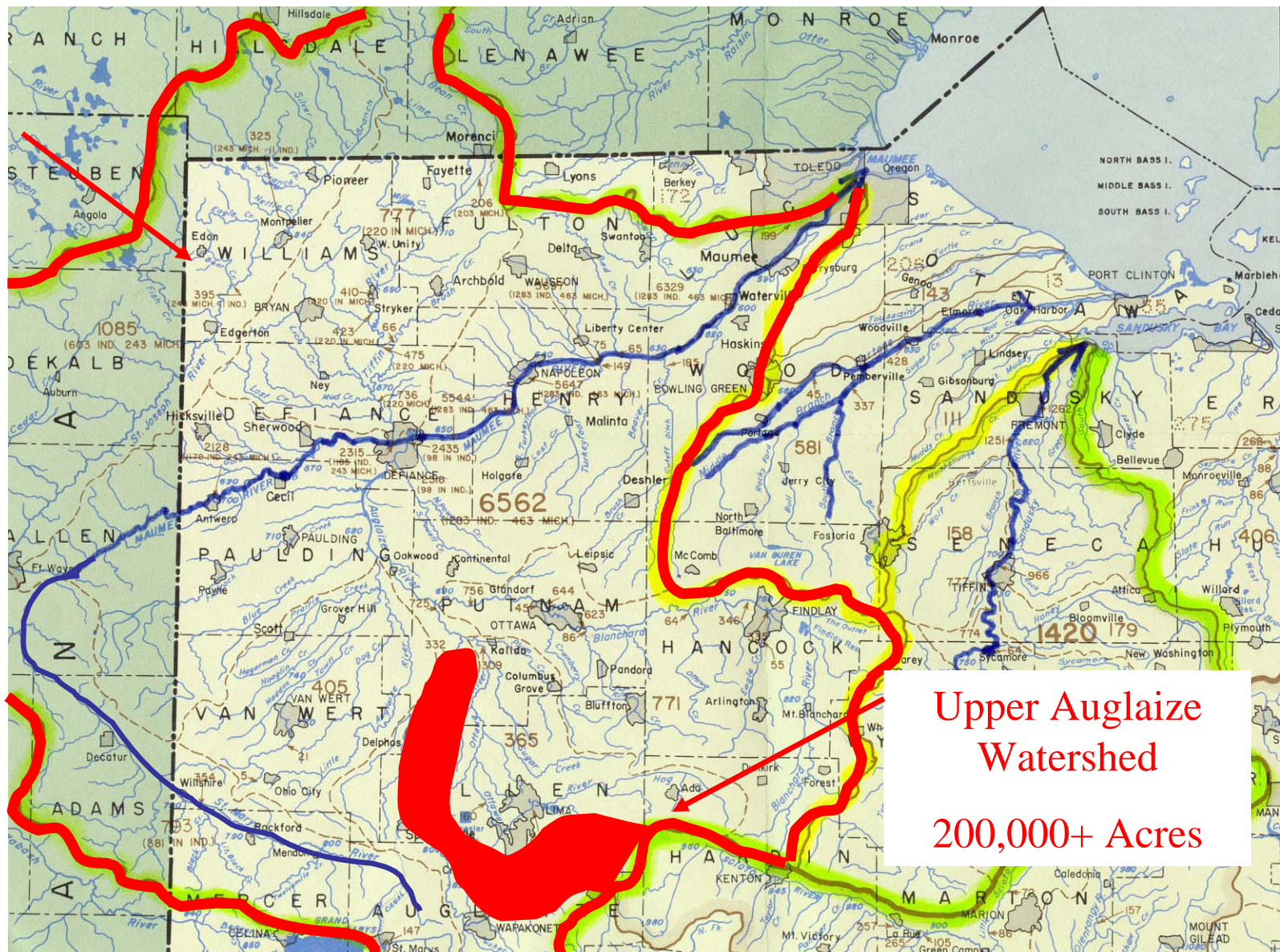
3. Predicted transport through stream system

The AGNPS Model ...



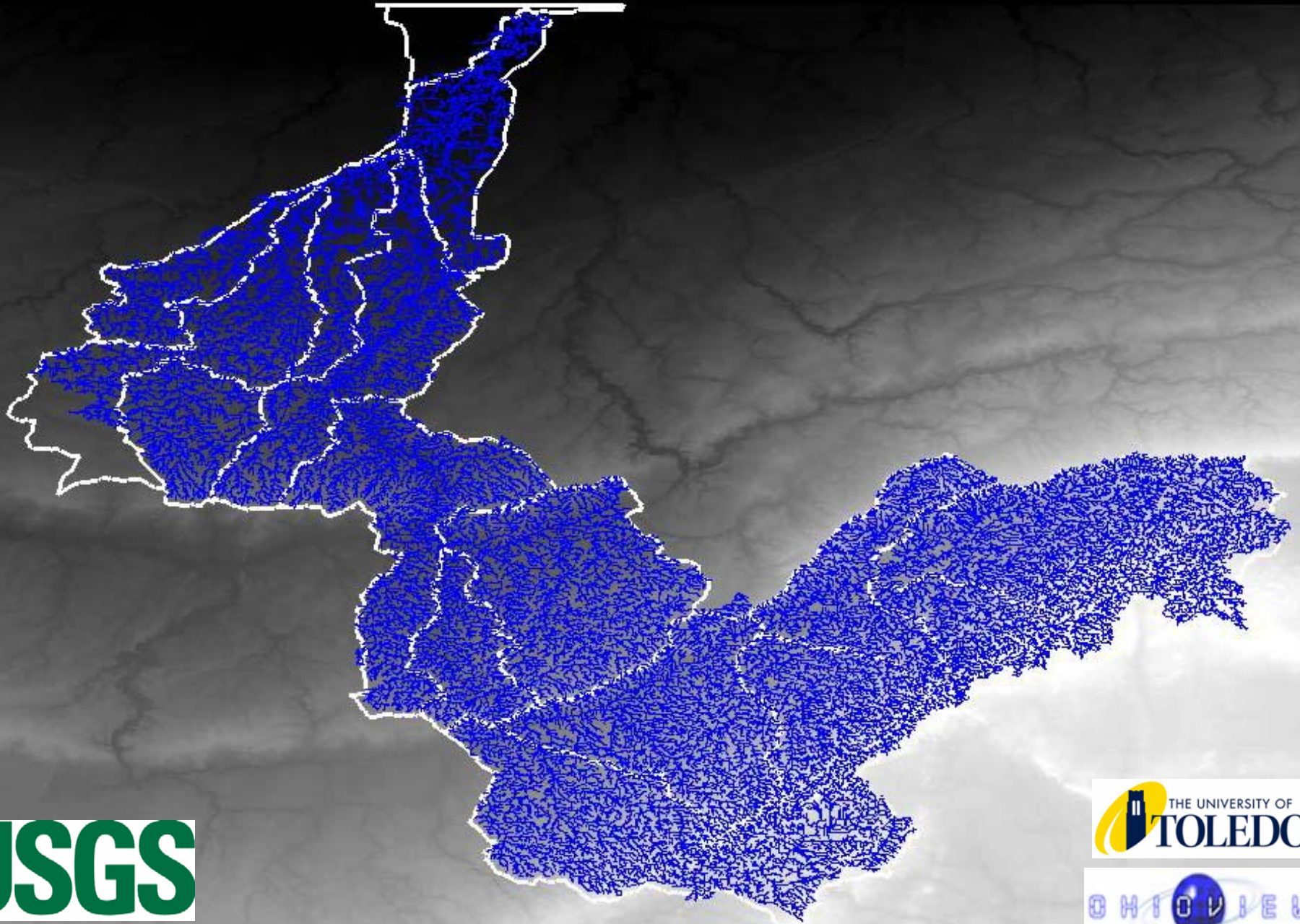
**WHAT WAS UNIQUE ABOUT
THIS PROJECT?**

**Maumee
Watershed
4,200,000
Acres**



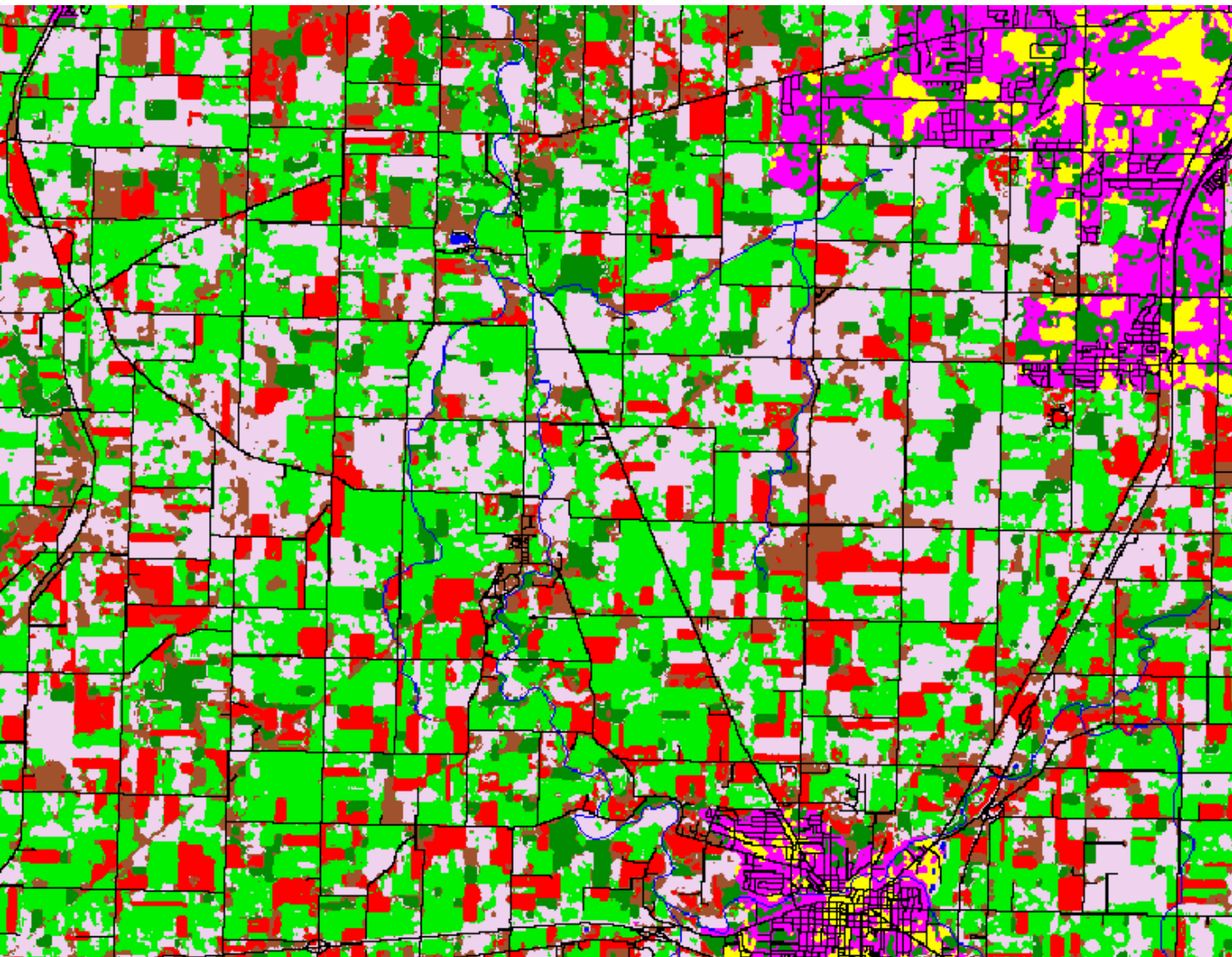
*....The watershed was almost entirely
composed of agricultural fields.*

AGNPS Cell Boundaries Were Computer Generated from a DEM



....Data input process was automated

Land-use Data Was Populated Via Remote Sensing

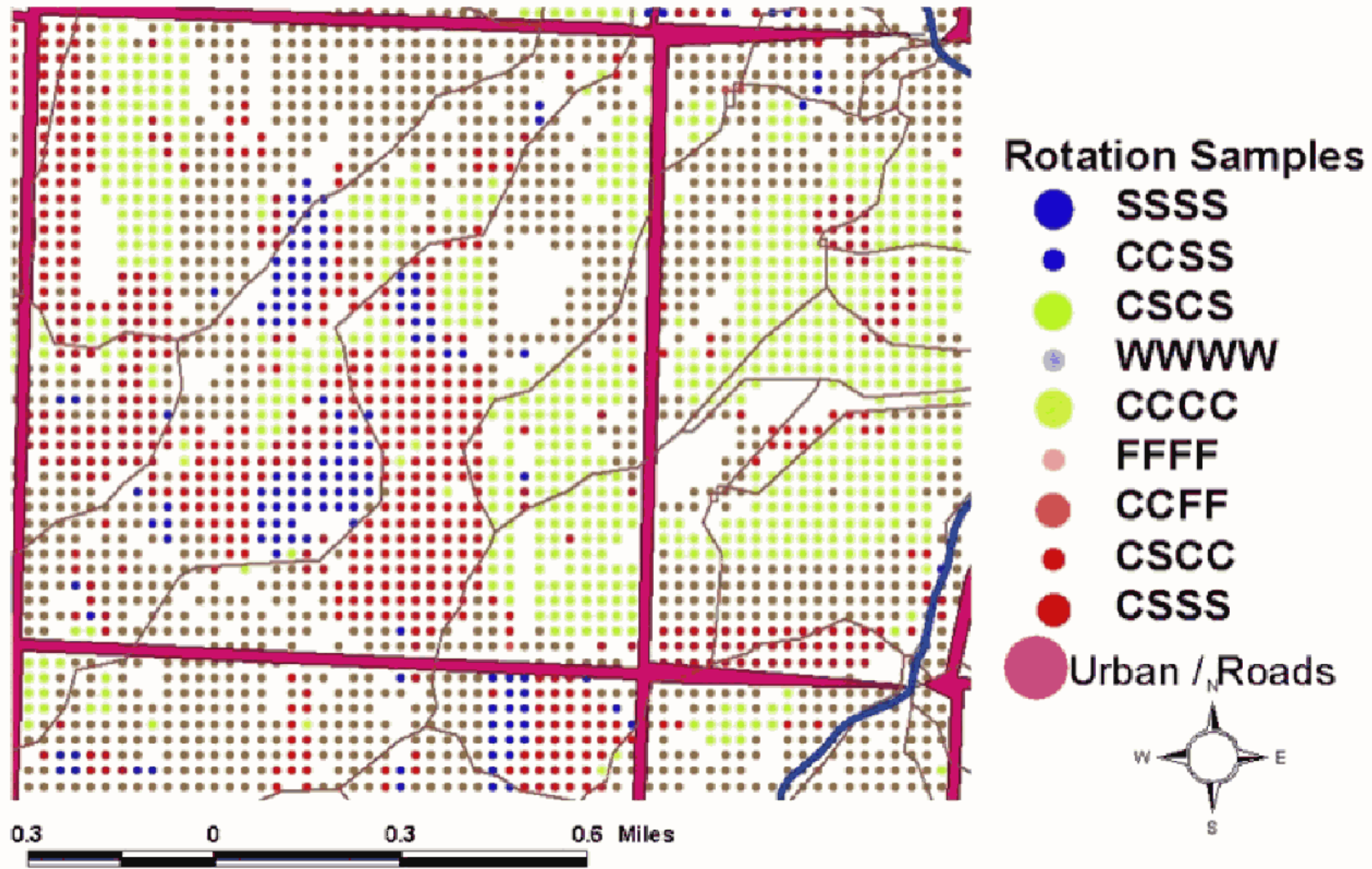


| | |
|-------------|--|
| wheat | |
| corn | |
| fallow | |
| beans | |
| forest | |
| residential | |
| commercial | |
| water | |
| roads | |



....Data input process was automated

Crop Rotation for AnnAGNPS



Conservation Tillage Transect Data Was Based on Transect Routes Within the Watershed

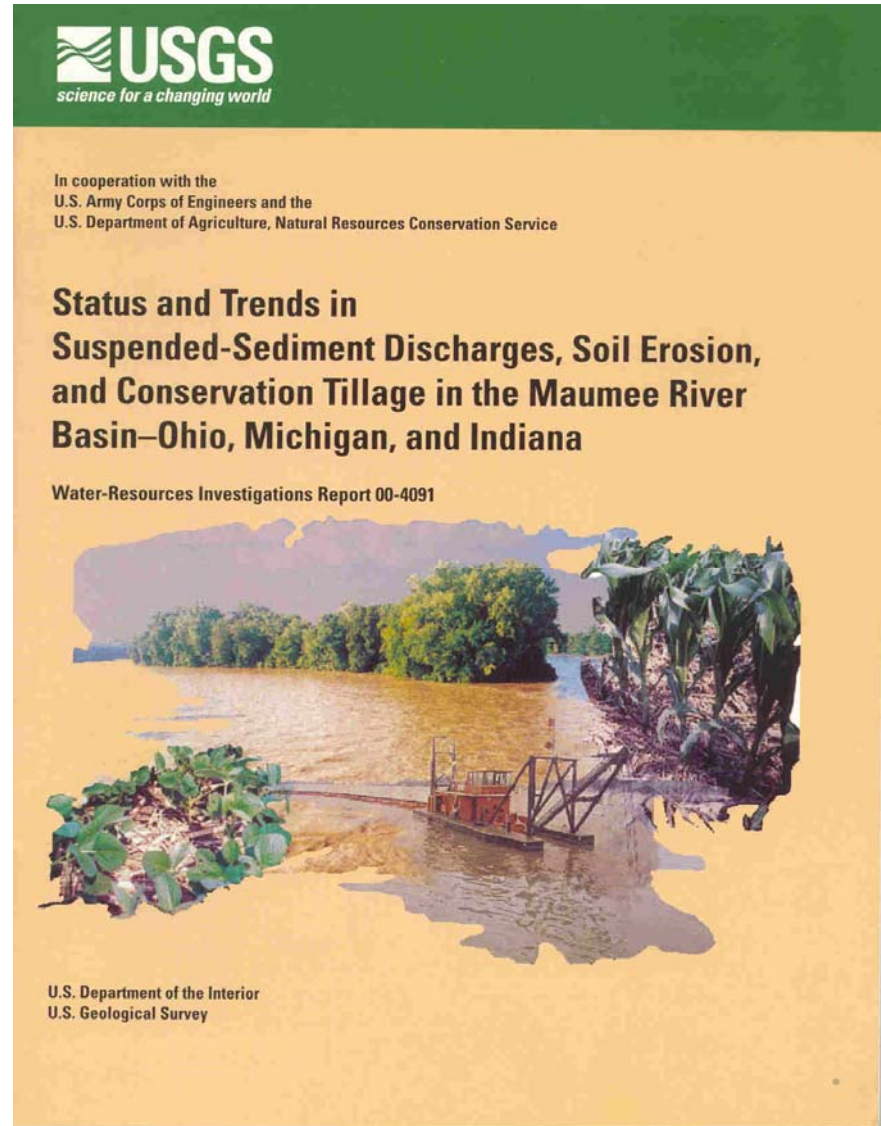


NRCS Natural Resources
Conservation Service



... Ephemeral gully routines were added to the model

The model was calibrated & outputs were validated using USGS stream gage data from Ft. Jennings . . .



**WHAT DO
RESULTS SHOW?**

Final Report Is Available On The Web At Ohio NRCS Home Page!

UPPER AUGLAIZE WATERSHED AGNPS MODELING PROJECT FINAL REPORT

Prepared For:

U.S. Army Corps of Engineers—Buffalo District

Prepared By:

TOLEDO HARBOR AGNPS PROJECT TEAM



Authors

Dr. Ron Bingner, Agricultural Research Service

Dr. Kevin Czajkowski, Michael Palmer and James Coss, University of Toledo

Steve Davis, Jim Stafford, Norm Widman, and Dr. Fred Theurer, USDA Natural Resources Conservation Service

Greg Koltun, U.S. Geological Survey

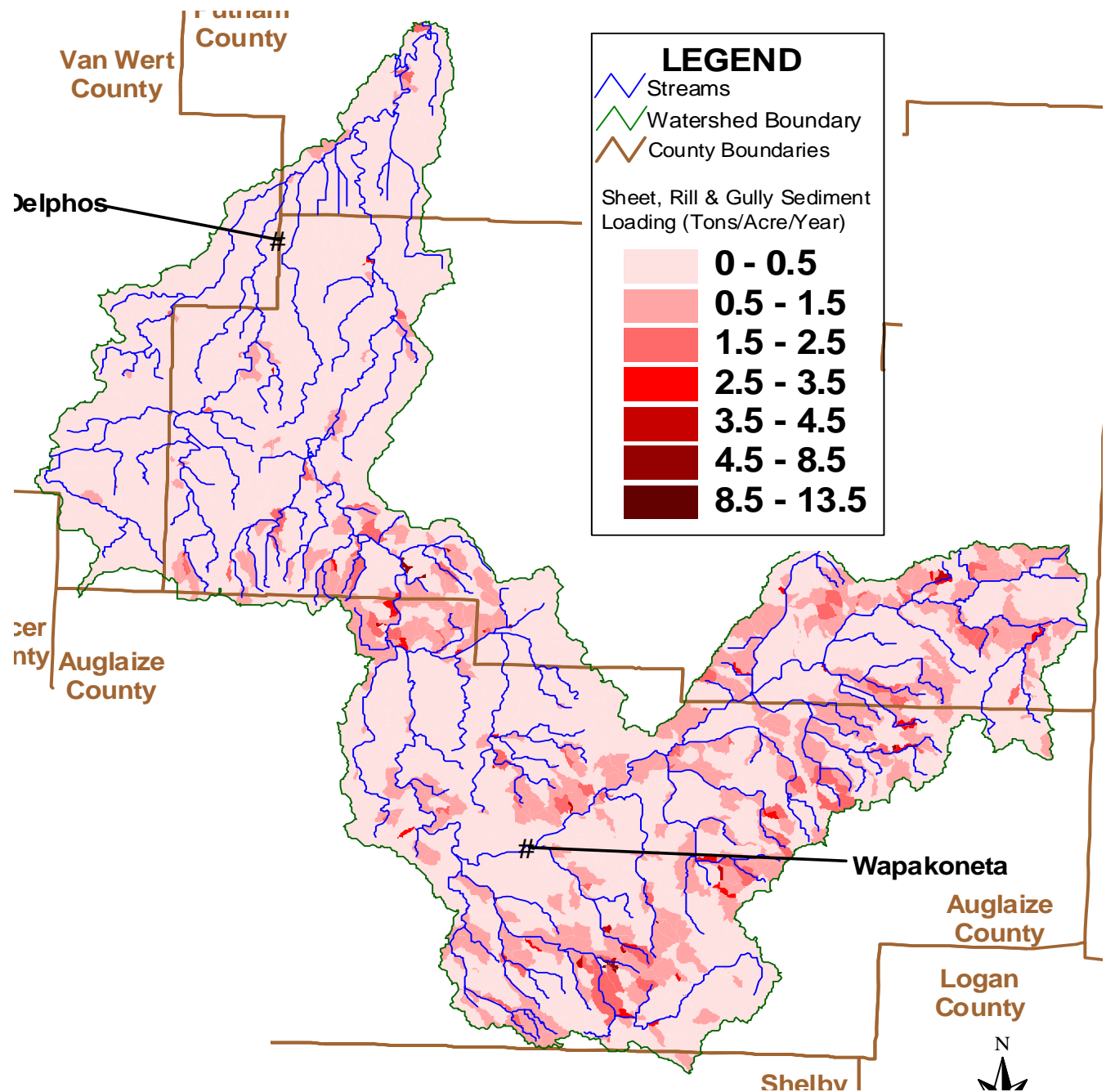
Dr. Pete Richards, Heidelberg College

Tony Friona, U.S. Army Corps of Engineers

What Do Results Show...

A watershed
comprised of
1833 cells
described the
spatial
variability of:

- erosion rates,
- runoff, &
- sediment
delivery
information

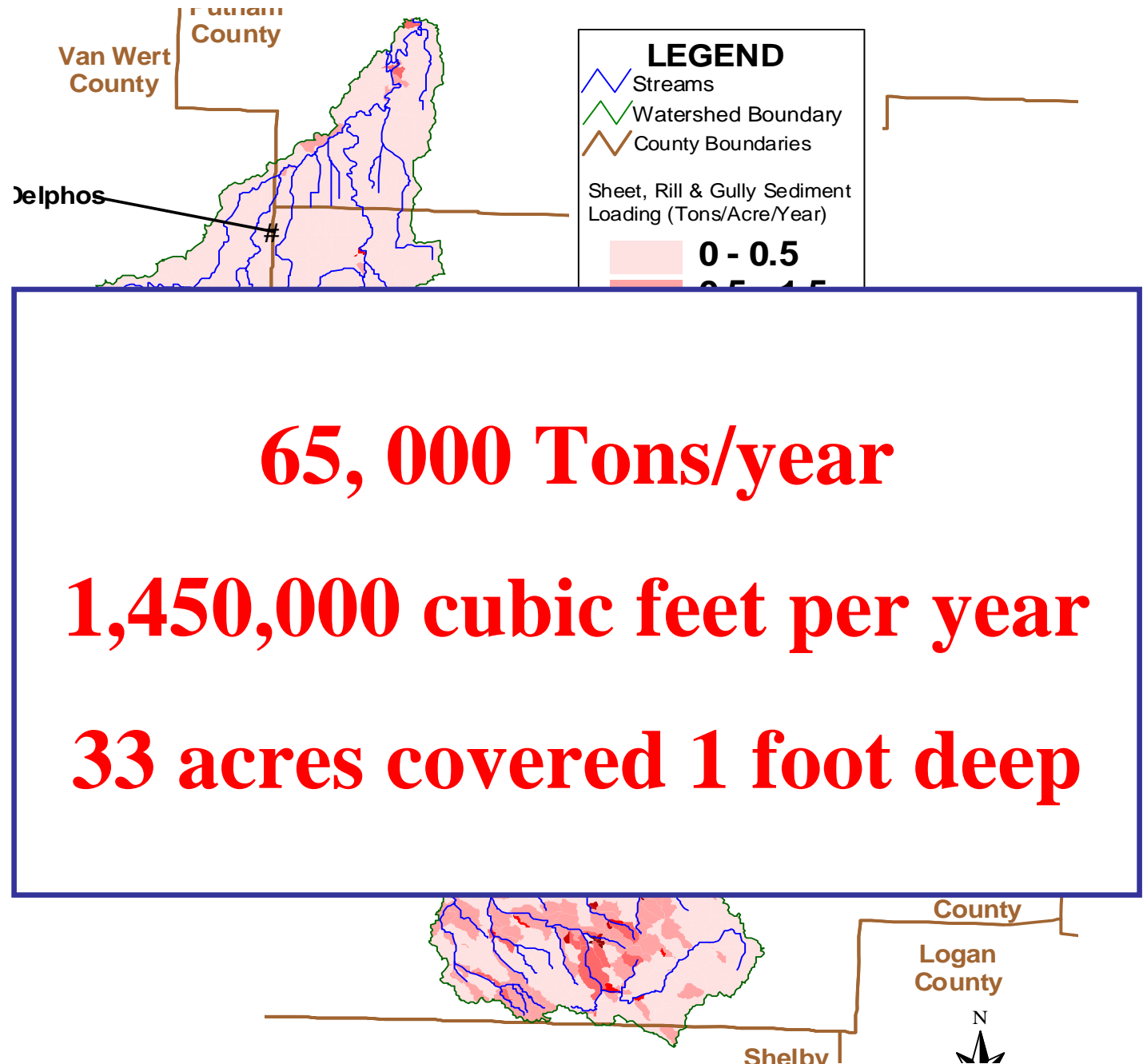


UPPER AUGLAIZE WATERSHED

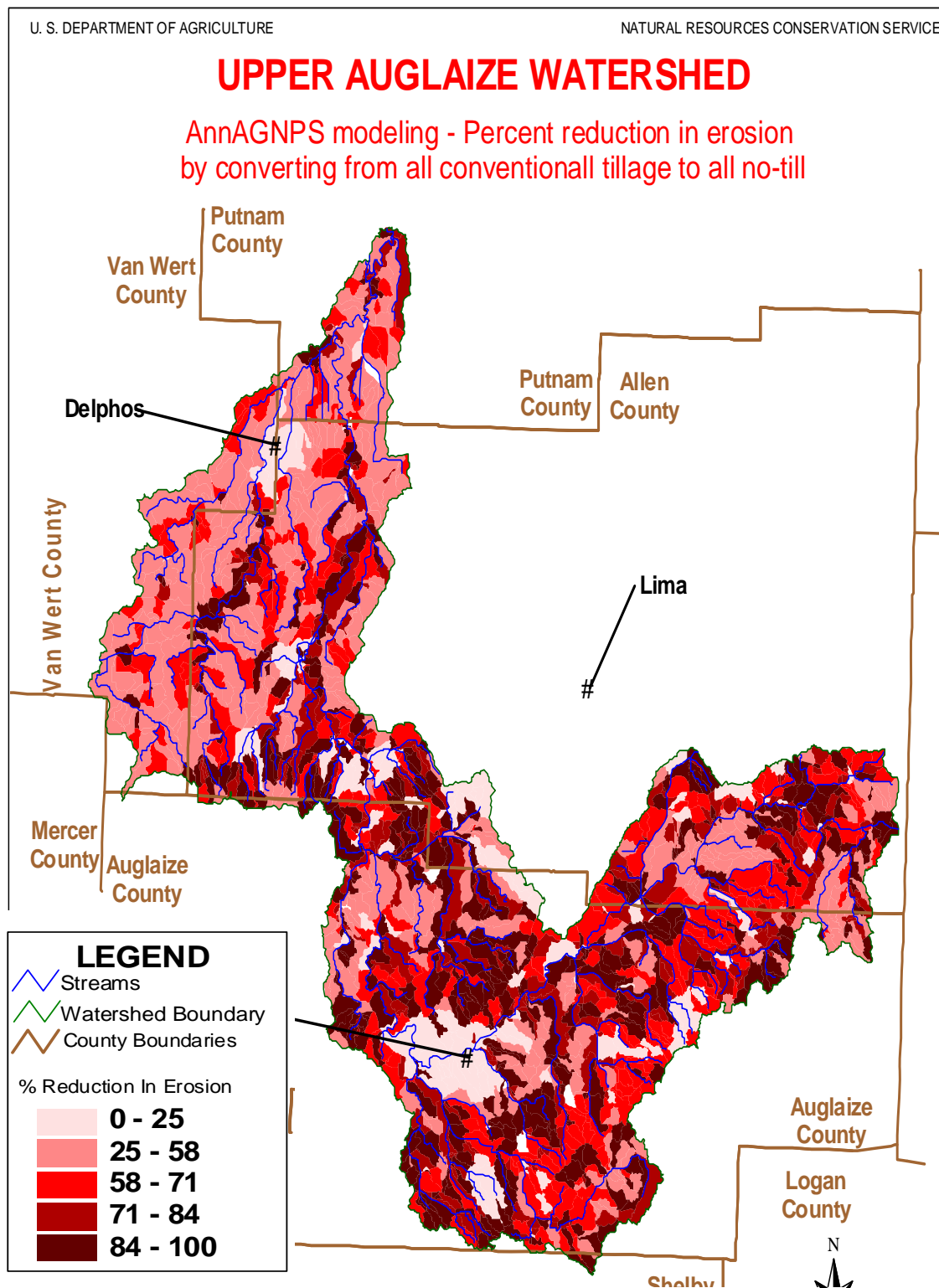
Existing Condition Sediment Load

Results show a lot of the watershed contributes a little bit of sediment per acre...

...But a big amount when all acres are totaled up!



**RESULTS SHOW
SIGNIFICANT
POTENTIAL FOR
SEDIMENT
REDUCTION BY
CONVERTING TO
NO-TILL**

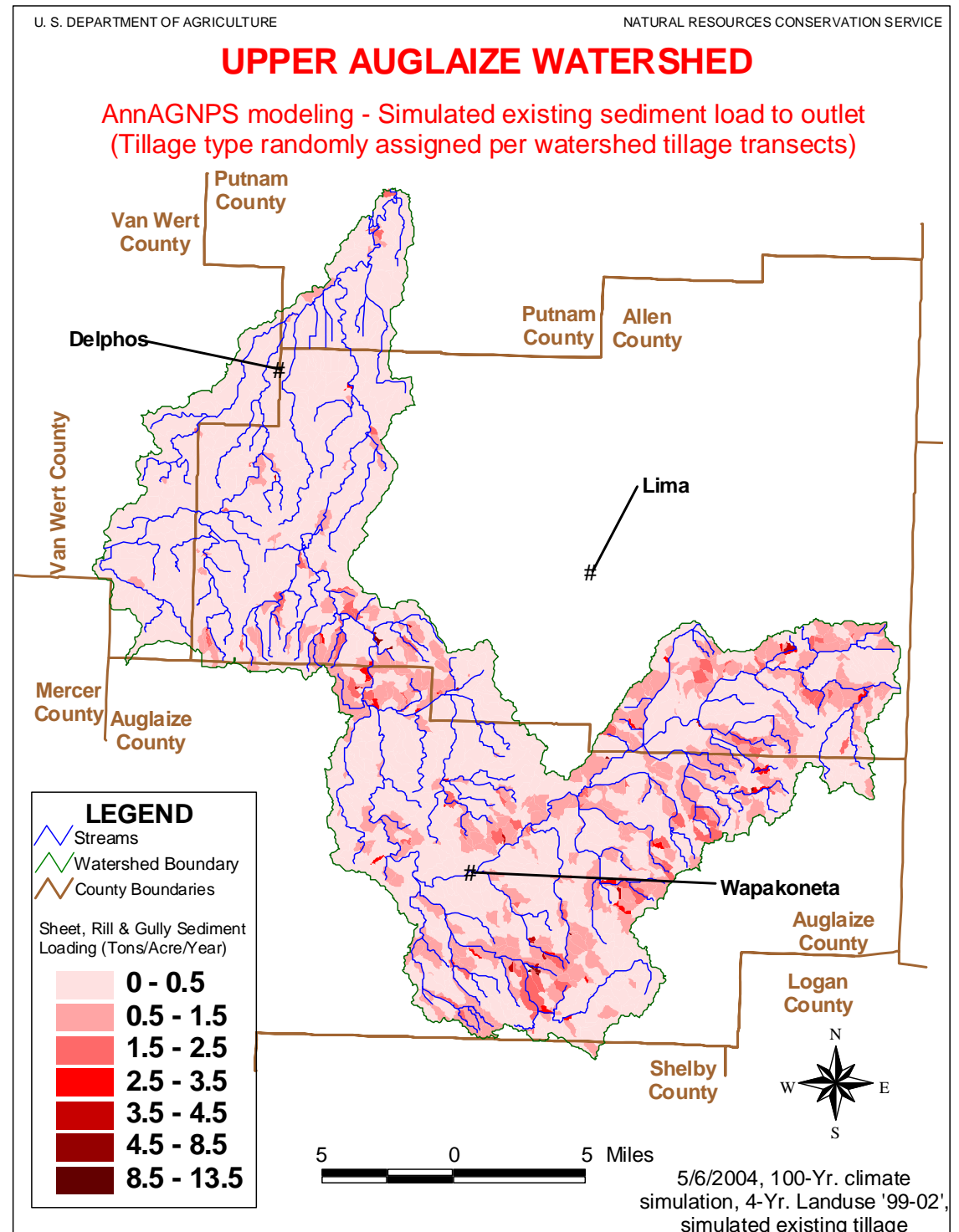


What do results show?

| | ALL Fall Plow | ALL No-Till | Units |
|-------------------------|----------------------|--------------------|-------------------|
| Runoff | 10.9 | 9.6 | Inches/Yr |
| Gross Erosion | 4.3 | 1.0 | Tons/Ac.Yr |
| Sediment Loading | .52 | .13 | Tons/Ac.Yr |

**Results Show Conservation Treatment Reduces
Erosion & Sedimentation 4 Fold!**

Results for
existing
conditions in
the watershed
were
estimated!

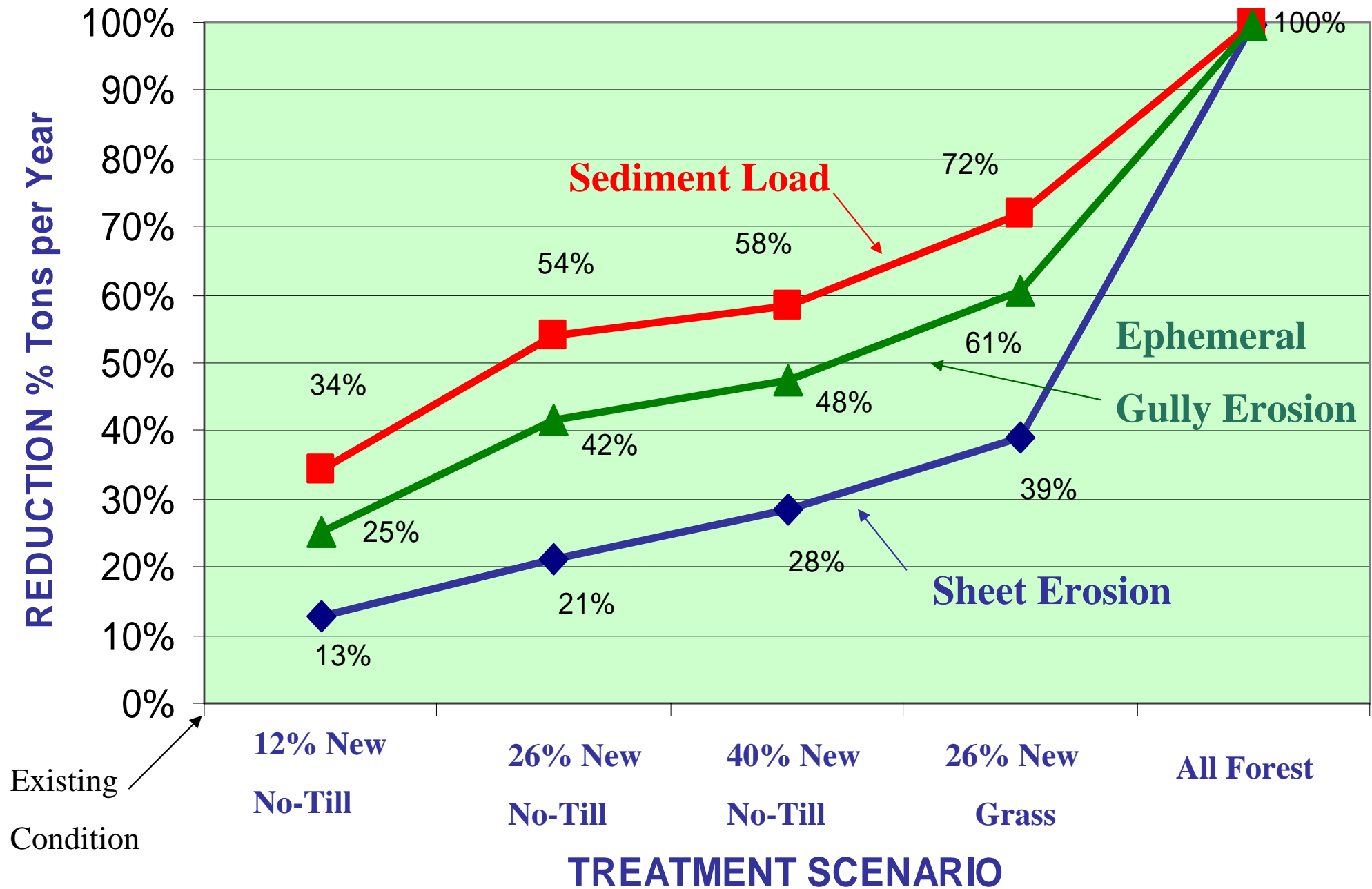


What do results show?

| | Fall Plow | Existing Condition | No-Till | Units |
|---------------------|-----------|-----------------------|---------|----------------|
| Runoff | 10.9 | 10.0 | 9.6 | Inches |
| Gross Erosion | 4.3 | 2.5 | 1.0 | Tons/Ac. Yr |
| Sediment Loading | .52 | .31 | .13 | Tons/Ac. Yr |

Results show we are half way to where we could be

EROSION REDUCTION - UPPER AUGLAIZE WATERSHED

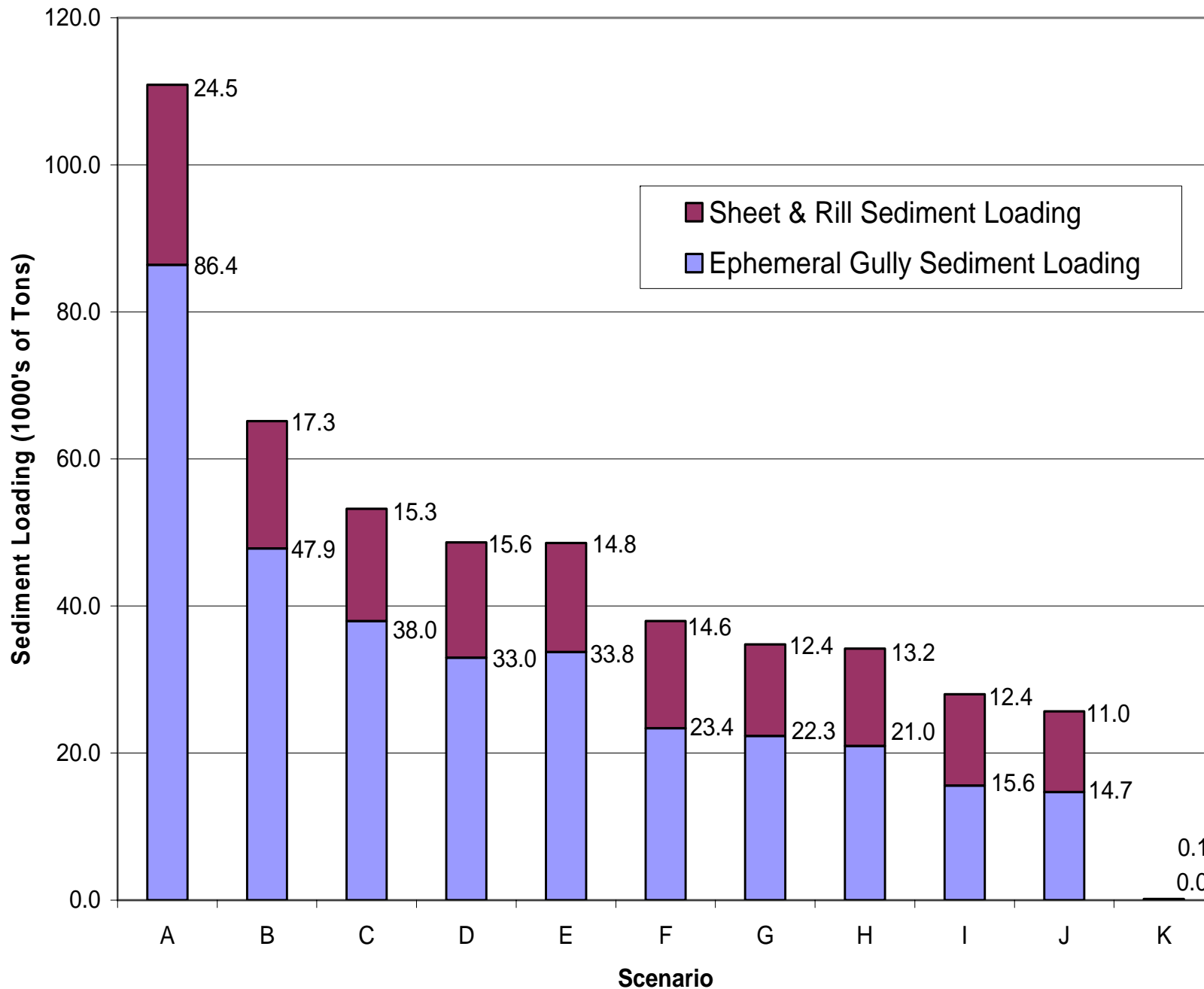


What do results show?



Results show ephemeral gullies were effectively modeled & found to be significant sediment source

Upper Auglaize Watershed Total Average Annual Sediment Loading At Ft. Jennings



Scenarios

- A.** All fall plow (alt.17)
- B.** Existing (alt.9)
- C.** 12.1% with highest erosion to no-till (alt.10)
- D.** Random 17.4% to no-till, 7.6% to grass (alt.16)
- E.** 7.9% with highest slope to grassland (alt.13)
- F.** 25.7% with highest erosion to no-till (alt.11)
- G.** 39.5% with highest erosion to no-till (alt.12)
- H.** 17.4% with highest slope to grassland (alt.14)
- I.** All cropland no-tilled (alt.18)
- J.** 27.1% with highest slope to grassland (alt.15)
- K.** All cropland converted to trees (alt.19)

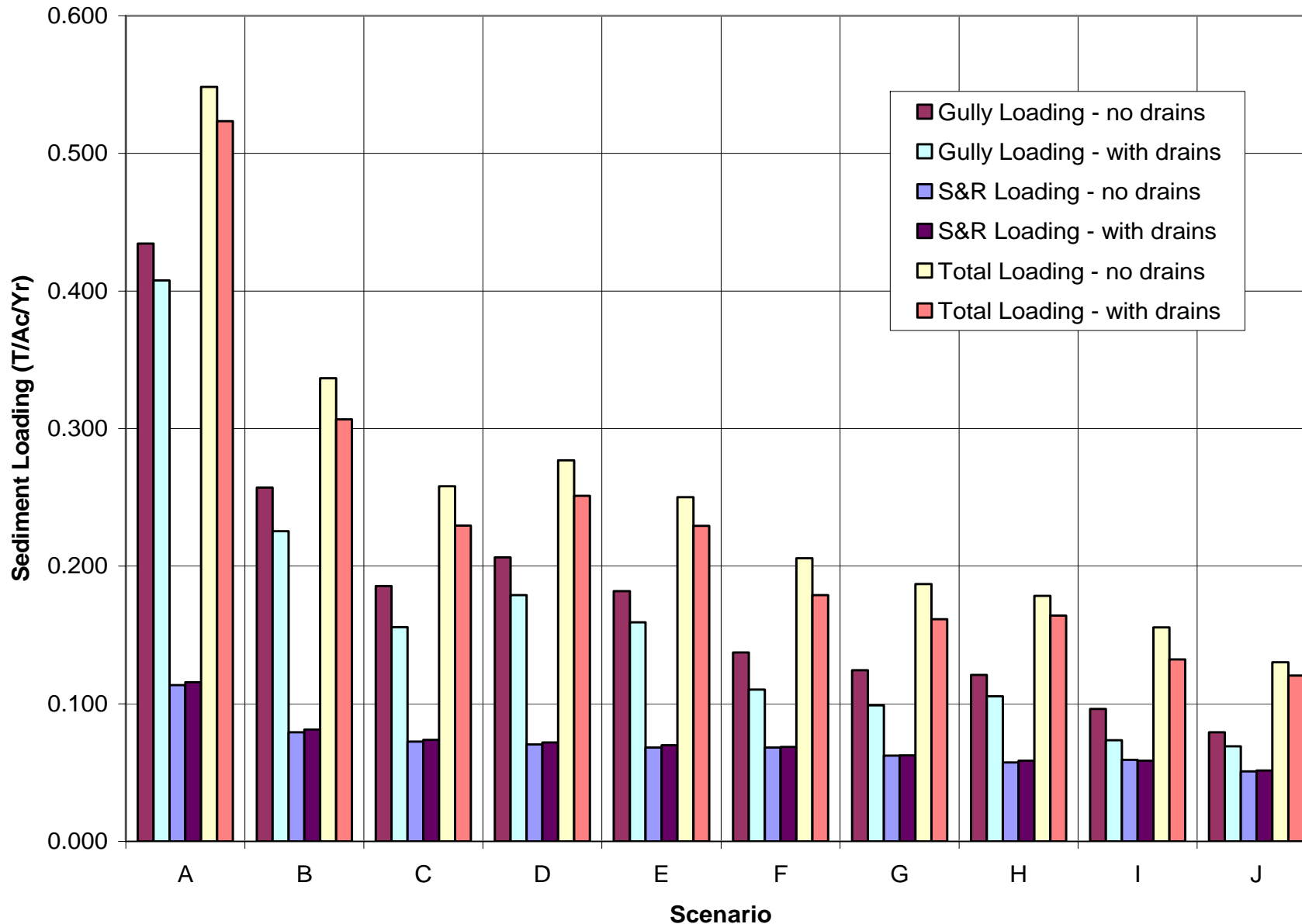
What do results show?



Results show capability of the model to simulate effects of tile drainage on soil erosion!

EFFECT OF TILE ON SEDIMENT YIELD

Upper Auglaize Watershed
Sediment Loading at Ft. Jennings - With and Without Drains



Scenarios

- A.** All fall plow (alt.17)
- B.** Existing (alt.9)
- C.** 12.1% with highest erosion to no-till (alt.10)
- D.** Random 17.4% to no-till, 7.6% to grass (alt.16)
- E.** 7.9% with highest slope to grassland (alt.13)
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- G.** 39.5% with highest erosion to no-till (alt.12)
- H.** 17.4% with highest slope to grassland (alt.14)
- I.** All cropland no-tilled (alt.18)
- J.** 27.1% with highest slope to grassland (alt.15)

COMPARISON OF UNIT AREA LOADINGS WITH AND WITHOUT TILE DRAINAGE – [t/ac/yr]

| Scenario | Unit Loadings With Tile Drainage [t/ac/yr] | Unit Loadings Without Tile Drainage [t/ac/yr] | Drained Loadings As Percent Of Undrained Loadings |
|----------------|--|--|---|
| A | 0.523 | 0.548 | 95.4% |
| B | 0.321 | 0.359 | 89.4% |
| C | 0.230 | 0.258 | 89.1% |
| D | 0.251 | 0.277 | 90.6% |
| E | 0.229 | 0.250 | 91.6% |
| F | 0.179 | 0.206 | 86.8% |
| G | 0.161 | 0.187 | 86.0% |
| H | 0.164 | 0.178 | 92.1% |
| I | 0.132 | 0.156 | 84.5% |
| J | 0.121 | 0.130 | 93.1% |
| AVERAGE | | | 89.2% |

Completed Study Results

| Summary of existing condition simulation output | | |
|---|---------|---------|
| Item | Amount | Units |
| Watershed Total Erosion | 524,000 | t/yr |
| Sediment Loading Amount to Watershed Outlet | 65,000 | t/yr |
| Highest Erosion rate from any Individual Cell | 77.0 | t/ac/yr |
| Watershed Average Sheet and rill Rate of Erosion | 0.7 | t/ac/yr |
| Watershed Average Ephemeral Gully Rate of Erosion | 1.8 | t/ac/yr |
| Watershed Average Total Rate of Erosion | 2.5 | t/ac/yr |
| Watershed Sediment Yield to Streams | 1.0 | t/ac/yr |
| Sediment Loading Rate to Watershed Outlet | 0.3 | t/ac/yr |

Conclusions:

- Model estimated 524,000 Tons/Year of gross erosion in the watershed
- but identified only 65, 200 Tons/Year of the sediment load reaches the mouth of watershed
- 12.4% of eroded sediment delivered out of watershed

Conclusions:

- Ephemeral gully erosion was identified as a significant source of sediment
- AGNPS model was successfully used to predict amount of ephemeral gully erosion
- When tile drainage was applied to watershed sediment loads were 89% of un-drained condition

Conclusions:

- Applying 12% additional no-till on highest eroding areas reduced sediment load at the mouth to **75%** of existing cond.
- Applying 17% no-till randomly plus 8% new grass reduced sediment loads to **82%** of existing condition
- Converting 27% acreage to new grass reduced load to **39%** of existing condition

What remains to be done?

Riparian buffer
and filter strip
module needs to
be developed.



What remains to be done?



The next step of the team is to look at nutrient transport.....

New Inputs to AGNPS Model

- **Fertilizer Application Rates**
 - Nitrogen
 - Corn
 - Wheat
 - Phosphorus
 - Corn
 - Soybeans
 - Wheat
 - Alfalfa

Additional Opportunities:

- Look at effect of tillage changes on nutrient export from watershed
- Look at effect of other types of cover crops such as annual ryegrass.
- Look at effect of rate or timing changes on export from watershed

Limitations:

- Ability to model manure applications
- Ability to apply tillage in real time manner rather than randomize
- Ability to account for nutrient trapping/processing in buffers